



## Forecasting the combined effects of urbanization and climate change on stream ecosystems: From impacts to management options

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### Abstract:

Streams collect runoff, heat, and sediment from their watersheds, making them highly vulnerable to anthropogenic disturbances such as urbanization and climate change. Forecasting the effects of these disturbances using process-based models is critical to identifying the form and magnitude of likely impacts. Here, we integrate a new biotic model with four previously developed physical models (downscaled climate projections, stream hydrology, geomorphology, and water temperature) to predict how stream fish growth and reproduction will most probably respond to shifts in climate and urbanization over the next several decades. The biotic submodel couples dynamics in fish populations and habitat suitability to predict fish assemblage composition, based on readily available biotic information (preferences for habitat, temperature, and food, and characteristics of spawning) and day-to-day variability in stream conditions. WE ILLUSTRATE THE MODEL USING PIEDMONT HEADWATER STREAMS IN THE CHESAPEAKE BAY WATERSHED OF THE USA, PROJECTING TEN SCENARIOS: Baseline (low urbanization; no on-going construction; and present-day climate); one Urbanization scenario (higher impervious surface, lower forest cover, significant construction activity); four future climate change scenarios [Hadley CM3 and Parallel Climate Models under medium-high (A2) and medium-low (B2) emissions scenarios]; and the same four climate change scenarios plus Urbanization. Urbanization alone depressed growth or reproduction of 8 of 39 species, while climate change alone depressed 22 to 29 species. Almost every recreationally important species (i.e. trouts, basses, sunfishes) and six of the ten currently most common species were predicted to be significantly stressed. The combined effect of climate change and urbanization on adult growth was sometimes large compared to the effect of either stressor alone. Thus, the model predicts considerable change in fish assemblage composition, including loss of diversity. Synthesis and applications. The interaction of climate change and urban growth may entail significant reconfiguring of headwater streams, including a loss of ecosystem structure and services, which will be more costly than climate change alone. On local scales, stakeholders cannot control climate drivers but they can mitigate stream impacts via careful land use. Therefore, to conserve stream ecosystems, we recommend that proactive measures be taken to insure against species loss or severe population declines. Delays will inevitably exacerbate the impacts of both climate change and urbanization on headwater systems.

**Source:** <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2695864>

### Resource Description

**Climate Scenario :** ☒

# Climate Change and Human Health Literature Portal

specification of climate scenario (set of assumptions about future states related to climate)

Special Report on Emissions Scenarios (SRES)

**Special Report on Emissions Scenarios (SRES) Scenario:** SRES A2, SRES B2

## **Communication:**

resource focus on research or methods on how to communicate or frame issues on climate change;  
surveys of attitudes, knowledge, beliefs about climate change

A focus of content

## **Communication Audience:**

audience to whom the resource is directed

Policymaker

## **Exposure :**

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Food/Water Security

**Food/Water Security:** Fisheries

## **Geographic Feature:**

resource focuses on specific type of geography

Freshwater, Urban

## **Geographic Location:**

resource focuses on specific location

United States

## **Health Impact:**

specification of health effect or disease related to climate change exposure

Health Outcome Unspecified

## **Mitigation/Adaptation:**

mitigation or adaptation strategy is a focus of resource

Adaptation

## **Model/Methodology:**

type of model used or methodology development is a focus of resource

Exposure Change Prediction

## **Resource Type:**

format or standard characteristic of resource

Research Article

**Timescale:** ☒

time period studied

Time Scale Unspecified

**Vulnerability/Impact Assessment:** ☒

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content